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The Moderating Effects of Executive Functioning on the Relationship between Life Stress and Depression

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The Moderating Effects of Executive Functioning on the Relationship between Life Stress and Depression

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The Moderating Effects of Executive Functioning on the Relationship between Life Stress and Depression

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Depression is a significant problem, which is often related to stressful life events. Individual responses to life stress can vary depending on vulnerability factors, such as ability to regulate emotions. Studies have demonstrated that emotion regulation involves executive functioning abilities. Executive functioning is not only associated with cognition, but also emotional and behavioral control. Difficulty with executive function is sometimes associated with depression. Though there is an established relationship in the literature between life stress and depression, the moderating effects of executive functioning on the relationship between life stress and depression remains unknown. This study will use multiple linear regression to test whether executive functioning moderates the influence of life stress on depression.

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INTRODUCTION

Current estimates of depression rates in the United States suggest that approximately 16% of people suffer from Major Depressive Disorder (MDD) at some point in their lives, with women diagnosed with depression nearly twice as often as men. (Kessler et al., 2003). The lifetime prevalence rate of depression ranges from 2% to 15% (Ustun & Chatterji, 2001). Depression is found to be the fifth leading cause of disability and disease burden worldwide. By the year 2020, it is projected to become the second leading cause of disability and disease burden (Michaund, Murray, & Bloom, 2001). The effects of depression are devastating and statistics show that it is becoming a significant problem, even more so than in previous years.

Depression is often precipitated and/or exacerbated by stressful life events, such as loss, threat, humiliation, or rejection (Hammen, 2005). Significant life events can lead to shifts in thoughts, mood, and behavior, which can lead to depression. Data suggest that approximately 50% of individuals diagnosed with depression have experienced severe stress before onset (Mazure, 1998).

Individual responses to life stress can vary depending on vulnerability factors including social, environmental, and cognitive influences (Beck, 1976; Hammen, 1992). Individual vulnerability to depression is also impacted by ability to regulate emotions. Emotion regulation refers to attempts individuals make to influence their experience and expression of emotion (Gross, 2007). Theorists posit that individuals who cannot manage their emotional responses to daily life events experience longer and more severe periods

of distress that may become diagnosable depression (e.g., Mennin, Holoway, Fresco, Moore, & Heimberg, 2007; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). For instance, research has shown that when feeling dysphoric, some people attempt to problem solve by brooding about their distress without taking action to solve problems (Nolen-Hoeksema, 1996; Lyubomirsky, Tucker, Caldwell, & Berg, 1999). Some well-researched emotion regulation strategies include suppression, reappraisal, and rumination. In a review by Aldao, Nolen-Hoeksema & Schweizer (2010), reappraisal was found to be a particularly helpful strategy across a variety of contexts.

Some studies have shown that emotion regulation strategies, such as reappraisal and suppression, draw fairly heavily on executive resources (Gross, 2002, Joormann & Gotlib, 2010; Levy & Anderson, 2008). Executive functioning, as described by Luria (1973), is essential for organizing intellectual activity as a whole, including the programming of the intellectual act and the checking of its performance. In a 2009 review by Banich, the definition of executive functioning is expanded to encompass the ability to effortfully guide behavior towards goals, particularly in novel situations. Neuropsychological tests of executive functioning measure cognitive flexibility, organization and planning ability, processing speed and fluency, inhibition, attentional control, rule detection, task initiation, and concept formation (Jurado & Rosselli, 2007).

Executive functioning deficits have been associated with difficulties coping with life stress (Klein & Boals, 2001) and problematic emotion regulation strategies (Davis & Nolen-Hoeksema, 2000). A central prediction of the proposed study is that these

executive functioning deficits contribute to vulnerability to depression. Researchers have theorized that underlying impairments in executive processes contribute to depressed individuals' difficulties in performing complex tasks, as well as ruminative tendencies (Levens, Muhtadie, and Gotlib, 2009).

In sum, research has found that life stress often precipitates depression, but successful coping with life stressors can occur, particularly in the presence of well-developed emotion regulation skills (Aldao et al., 2010). Though there is an established relationship in the literature between life stress and depression, the potential moderating effects of executive function on the relationship between life stress and depression remains unknown. This study will test whether executive functioning moderates the influence of life stress on depression.

INTEGRATIVE ANALYSIS OF THE LITERATURE

Prevalence of Depression

In the Diagnostic and Statistical Manual of Mental Disorders, fourth edition, text revised (DSM-IV-TR), depression is noted to include difficulties with mood, as well as changes in sleep, interests, energy, physiomotor performance, and cognitions (American Psychiatric Association, 2000). The National Comorbidity Study Replication (NCS-R), which was a household survey conducted between February 2001 and December 2002, found that 19.2% of American adults reported at least one depressive episode in their lifetime (Kessler et al., 2010). Research has found that of 240,000 people in 60 countries, depression alone was more debilitating than chronic physical diseases including asthma, angina, arthritis, and diabetes (Moussavi et al., 2007). This study found that those with both major depressive disorder (MDD) and a physical disease had lower health scores than those with physical health problems alone. The economic burden of depression is also substantial. Greenberg and colleagues found that as of the year 1990, the economic cost of depression was $77.4 billion annually (Greenberg et al., 2003). By the year 2000, the cost of depression rose to approximately $83 billion annually (adjusted for inflation), as measured by health care costs and hours of work lost. Depression was also found to be the fourth leading source of the global burden of disease among all diseases and disorders, as measured by disability adjusted life years (DALYs), and the leading cause of disability when measured by years living with disability (YLDs) in the year 2000 (Ustun, Ayuso-Mateos, Chatterji, Mathers, & Murray, 2004).

These findings underscore the importance of research concerning depression and further understanding of significant contributors and individual differences that could impact/augment the prognosis of affected individuals.

Relationship between Depression and Life Stress

Daily, individuals must adapt and respond to life's demands, successes, disasters, and changes, particularly in a social context. Research has demonstrated that life event stressors often precipitate depressive episodes (Mazure, 1998; Hammen, 2005). Mazure (1998) reported that an estimated 50-80% of depressed persons report a recent, severely stressful life event prior to onset of initial depressive episode. Studies have yielded similar, consistent results finding associations between recent exposure to stressful life events and onset of episodes of major depression (Hammen, 2005). Importantly, there are factors about life stressors themselves that can contribute to the development of depression, as well as individual differences that contribute to vulnerability to depression.

Life stress and depression

In reviews of the large body of literature on the relationship between life stress and depression, Hammen (2005) and Mazure (1998) indicate that stressful life events often lead to depression, and that many factors concerning life events themselves contribute to this relationship. In seminal work by Brown and Harris (1978), research found that the presence of at least one impactful stressor can lead to subsequent depression. Events incurring loss have been found to be particularly potent; such job loss

(Dew, Bromet, & Schulberg ,1987), death of a spouse (Umberson, Wortman, & Kessler, 1992), and divorce (Aseltine & Kessler 1993).

Stress-Exposure Perspective

Research has demonstrated that individuals who have been exposed to stress will have more depressive symptoms than those who have not (Adrian & Hammen, 1993). Prospective studies showing that stress typically precedes increases in symptoms of depression have provided support for this perspective (e.g. Rudolph, Kurtakowsky, & Conley, 2001; Hammen, Henry & Daley, 2000). For example, Rudolph and colleagues researched the precursors and emotional consequences of maladaptive beliefs concerning ability to produce desired outcomes when putting forth effort. Research found that in adolescents, recent stress and family disruption contributed to feeling increased levels of helplessness and higher levels of depressive symptoms (Rudolph et al., 2001). Similarly, Hammen and colleagues found that women who experienced much childhood adversity, such as family violence and parent psychopathology, were more likely to become depressed following less total stress than women without such adversity, and results could not be accounted for by chronic stress or prior depression (Hammen et al, 2000).

Life-stress, event matching theory

Research has demonstrated that experiencing relationship stressors, which threaten loss and/or rejection, are common in depression, particularly in women (Tennant, 2002). These events can be particularly devastating for individuals with depressive interpersonal cognitive and personality representations, or schemas (Beck,

1983). The hypothesis that schemas could affect interpretations of life stressors has been extensively researched. Schemas about the self and others contribute to appraisals of events (Hammen, 2005), which can lead to psychopathology. An example noted in Hammen (2005) is a schema of a person with high value of social relationships, or a sociotropic person, being more affected by an interpersonal loss than someone who does not place the same value on relationships. These experiences thereby trigger depression for sociotropic individuals, but not for others. The life-event matching model, also referred to in the literature as the congruency model, describes the interactions between vulnerability factors and matching life events, which produce depression. Similarly, the personal relevance of stressors has been found to be of particular importance in the life stress-depression relationship, with personally meaningful events causing greater likelihood of a depressive episode (Hammen, Ellicott, & Gitlin, 1989).

Vulnerability to Depression: Recurring Episodes

Another facet of the life-stress literature is the finding that individuals who experience recurrences of depression require progressively less life stress to initiate depressive episodes. Post and colleagues (Post, Rubinow, Ballenger, 1984) introduced the hypothesis that recurrent depression can become progressively independent of stressors, as a function of neurobiological changes associated with repeated stressors and episodes that create a sensitization "kindling." This is posited to lead to more spontaneous episodes of depression. Several studies suggest that stressful life events are significantly more likely to occur prior to first or second episodes of depression than prior

to recurrent depressions (Dolan, Calloway, Fonag, deSouza, & Wakeling, 1985; Ezquiaga, Gutierrez,& Lopez, 1987; Ghaziuddin, Ghaziuddin, & Stein,1990). The kindling effect has been particularly salient in studies of individuals diagnosed with unipolar depression. Thus, results suggest that life events are more common prior to first versus recurrent depression.

Stress generation

The stress generation model (Hammen, 1991, 1992) is another aspect of vulnerability in which individuals with psychopathology, particularly depression, tend to generate stressors which are not always occurring by chance, but are dependent upon the characteristics of the person and occur as a function of their own behavior. For instance, in a short-term longitudinal study of college freshman, self-reports of depressive symptoms were associated with stressors two weeks later, indicating that the individuals with more depressive symptoms experienced more life stress in just two weeks than those with less depressive symptoms (Potthoff, Holahan, & Joiner, 1995). The bidirectional association between stress and depression has obfuscated the boundary between vulnerability and stress.

Responding to Life Stress: Vulnerability to Depression

While the main focus of this prospectus will be on executive function as a moderator for the relationship between life stress and depression, it is worth noting that there are well-researched cognitive factors which are known to contribute to vulnerability to depression. Beck's cognitive vulnerability theory underscores the importance of

cognitive appraisal in vulnerability to depression, positing that depressive cognitive schemas influence individual vulnerability (Beck, 1976). The notion of depressive cognitive schemas is represented in the Negative Cognitive Triad model posited by Beck. This model indicates that negative cognitions center around the self, the world, and the future for some individuals.

Cognitive vulnerability factors increase the impact of life stress. Another cognitive factor involved in responding to life stress is the regulation of emotions (Gross, Richards, & John, 2010). Conscious communication and regulation of emotions comes from the concept of conscious coping, or "cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the personal resources (Lazarus & Folkman, 1984, p. 141). How people regulate their emotions is thought to have important consequences for how well they cope with adversity and is gaining interest as a possible vulnerability factor in depression (e.g. Nolen-Hoeksema et al., 2008; Mennin et al., 2007).

Definitions of Emotion Regulation

Emotion regulation has been identified a few different ways. In early work by Thompson (1991), emotion regulation is described as the extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions. Similarly, Gross defines emotion regulation as attempts individuals make to influence which types of emotions they have, when they have them, and how emotions are experienced and expressed (Gross, 1998, 2007). Further, Koole (2009) describes emotion regulation as the set of deliberate, effortful processes whereby people seek to redirect the spontaneous

flow of their emotions. Emotion regulation helps people resist being taken by the immediate emotional impact of a situation.

Conceptualizations of Emotion Regulation

Koole (2009) emphasizes that emotion regulation strategies are a set of processes whereby people seek to redirect the spontaneous flow of their emotions, largely to minimize negative emotions. He posits that emotion regulation determines how easily people can leave a given emotion state. The principle targets of emotion regulation are attention, cognitive emotion-relevant knowledge, and bodily manifestations of emotions. These serve the functions of promoting satisfaction of needs, supporting goal pursuits, and maintaining the global personality system. The need-oriented function includes the strategies of turning attention away from negative information (i.e. attentional avoidance (Derakshan, Eysenck, & Myers, 2007)), interpretive biases (i.e. cognitive dissonance reduction (Harmon-Jones, & Mills, 1999)), and bodily activities (i.e. stress-induced eating, (Greeno & Wing, 1994)). Goal-oriented functions include strategies of distraction through cognitive load (i.e. thought suppression, (Wenzlaff & Wegner, 2000)), cognitive reappraisal (Ochsner & Gross, 2008), and bodily activities (i.e. expressive suppression, (Gross, 1998)). The personality-oriented function includes strategies of attentional counter-regulation (i.e. meditation, (Cahn & Polich, 2006)), cognitive activities (i.e. expressive writing, (Pennebaker, 1997)), and bodily activities (i.e. controlled breathing, (Philippot, Chapelle, & Blairy, 2002)).

Another conceptualization of emotion regulation is posited by Gross (1998). In his conceptualization of emotion regulation, Gross (1998) indicated that emotion

regulation strategies can be differentiated along the timeline of unfolding emotional responses. The concept begins with an evaluation of an emotional cue, which subsequently triggers coordinated sets of response tendencies that involve experiential, behavioral, and physiological systems. These responses over time include antecedent-focused and response-focused emotion regulation strategies.

Antecedent-focused strategies are things done prior to responding to the emotion. This strategy attempts to modify the likelihood or experience of a stressor to prevent or reduce the amount of distress it creates. Cognitive reappraisal, or construing a potentially emotion-eliciting situation in a way that changes its emotional impact (Lazarus & Alfert, 1964), is an example of antecedent-focused emotion regulation. Response-focused strategies are things done once the emotion is underway. Expressive suppression, or inhibiting ongoing emotion-expressive behavior (Gross, 1998), is an example of response-focused emotion regulation. Within these two types of strategies, Gross posits a process model of emotion regulation that highlights five families of emotion regulation strategies (Gross & Thompson, 2007). The five families include situation selection, situation modification, attentional deployment, cognitive change, and response modulation. Four of these families are considered antecedent-focused strategies, including situation selection, situation modification, attentional deployment, and cognitive change. The fifth family is response modulation, which is considered a response-focused strategy.

The first family, situation selection, involves taking actions to make it more likely that the situation will give rise to desirable emotions. Thus, individuals may try to avoid situations that are known/thought to bring about negative emotions (e.g. avoiding confrontation), even if the long-term consequences could be detrimental. Secondly, situation modification is conceptualized as an attempt to modify the situation directly so as to alter its emotional impact (e.g. making a joke about a bad situation). In the stress and coping literature, this is known as "problem-focused coping" (Lazarus & Folkman, 1984). Situation modification involves modifying, or problem-solving with external, physical environmental factors. The third family is attentional deployment. Attentional deployment involves regulating emotions without changing the environment, or influencing emotional responding by redirecting attention within a given situation. Attentional deployment can involve physical withdrawal of attention (e.g. covering the eyes), internal redirection of attention (e.g. distractions), and responding to external redirection of attention (e.g. a parents redirection of a hungry child by telling the child an interesting story). In this conceptualization, Gross considers rumination "inflexibility in inner-directed attention." The fourth family is cognitive change. This refers to changing one or more appraisals in a way that alters the situation's emotional significance by changing how one thinks either about the situation itself or about one's capacity to manage the demands it poses. Reappraisal is a form of cognitive change that has been widely researched (e.g. Gross, 2002). Lastly, response modulation refers to influencing physiological, experiential, or behavioral responses directly. Expressive suppression,

which is an attempt to decrease ongoing emotion-expressive behavior, is an example of response modulation.

The conceptualizations are similar in that they indicate that emotion regulation can be cognitively regulated, effortful, and controlled in nature. Koole notes that while the primary emotional response reflects emotional sensitivity, secondary emotional responding reflects emotion regulation and is distinct because it involves a controlled, cognitive process consisting of the monitoring and adjusting of a lower-level process. Gross's view of emotion regulation as an antecedent- or response- focused process is also consistent with the idea of an effortful, self-monitored process. The conceptualization of emotion regulation as a self-monitored, controlled, effortful process implies that executive functioning is somehow involved.

Descriptions of emotion regulation strategies

Reappraisal

Reappraisal involves changing a situation's meaning in such a way that there is a change in the person's emotional response to that situation (Gross, 2002). Gross and colleagues have found evidence to suggest that reappraisal occurs fairly early on in the emotion-generative cycle, indicating that it alters the experiential, behavioral, and physiological components of the emotional response without incurring substantial cost (Richards & Gross, 2006). Cognitive models of depression posit that maladaptive reappraisal strategies can cause depression (Beck, 1976), while adaptive reappraisal strategies can lead to positive emotional and physical responses to emotional stimuli

(Gross, 1998). In fact, Stemmler (1997) has shown that reappraisal can decrease physiological responding in a negative interpersonal situation. Reappraisal has been found to activate prefrontal regions of the brain (Ochsner, Ray, Gabrielli, & Gross, 2004) and involves an effortful cognitive process requiring attention and abstraction (Berkman & Lieberman, 2009).

Suppression and Avoidance

Expressive suppression is a form of response modulation that involves inhibiting, or decreasing ongoing emotion-expressive behavior (Gross, 2002). Gross (1998) found that use of suppression of emotional expressions and physiological arousal short term can be beneficial; however, over the long term it can lead to ineffective emotion regulation abilities (Gross, 1998; Gross & Thompson, 2007), hypersensitivity to depression (Wegner & Zanakos, 1994), and increased accessibility to the suppressed thought (Wegner & Erber, 1992). Avoidance is similar to suppression such that avoiding negative thoughts and feelings can also feel helpful short term, but be maladaptive if used long term and result in negative emotional outcomes and behavior problems (Wenzlaff & Wegner, 2000). Findings have been mixed with regard to the relationship between executive control and suppression/avoidance. Some research has found that suppressing unwanted memories and thoughts is associated with greater executive control (Andrerson, Oschner, et al., 2004; Levy & Anderson, 2008), while other studies have found that reduced executive control is related to greater use of suppression (Joormann and Gotlib, 2010).

Distraction

Distraction involves shifting attention away from the emotional or situational aspects of a situation. Distraction involves a change in internal focus, such as remembering thoughts and feelings inconsistent with the undesirable emotional state. In a review by Nolen-Hoeksema et al. (2008), it was reported that when dysphoric people are distracted from negative thoughts, it can lead to positive appraisal of situations, better problem solving, and less distress; however, these effects seem to be temporary. Research has also found that perpetual use of distraction can become problematic and manifest as avoidant behaviors.

Rumination

Rumination is conceptualized by Nolen-Hoeksema as a maladaptive response style in which individuals respond to distress in a way that involves repetitively and passively focusing on symptoms (Nolen-Hoeksema, 1991). Rumination is associated with a weak problem solving orientation, poorer problem solving skills, and more negative appraisals of situations. Research has found that the motivation to ruminate is often because people want to understand and solve their problems (Papageorgiou & Wells, 2003); but leads to poorer problem solving (Hong, 2007). Studies have revealed that rumination is positively related to suppression and avoidance of distressing feeling and thoughts (Nolen-Hoeksema & Morrow, 1993; Wenzlaff & Luxton, 2003). In fact, Wenzlaff and Luxton (2003) suggest that suppression and avoidance can fuel rumination. Research has demonstrated that depression-vulnerable populations, such as college

students with previous depression, are particularly susceptible to rumination (Gortner, Rude, & Pennebaker, 2006). Rumination was also found to predict onsets of major depression up to one year later (Holen-Hoeksema, Larson, & Grayson, 1999). Rumination has been associated with significant emotional and cognitive difficulties. In fact, Davis and Nolen-Hoeksema (2000) found that rumination was negatively correlated with executive control. Whitmer and Banich (2007) also found that in a nondepressed sample, individuals who had high scores on the 'reflection' and 'brooding' subscales of a rumination measure had more difficulty inhibiting previously learned responses.

Problem Solving

Another emotion regulation strategy is problem solving. Problem-solving is a conscious attempt to alter or contain a stressful situation and its consequences, such as brainstorming solutions or planning a course of action (Aldao et al., 2009). The strategy of problem solving acts as a cognitive emotion regulation skill by eliminating stressors, having subsequent positive effects on mental health. Poor problem solving skills are thought to contribute to depression (Billings & Moos, 1981).

In sum, deliberate cognitive efforts to reappraise and problem solve at the antecedent-focused period in Gross's model have been associated with positive outcomes, whereas more automatic, schema-driven emotion regulation strategies during the response-focused period are found to be less beneficial long term. Cognitive resources are needed to employ effortful emotion regulation strategies; however, it is noteworthy that though effortful emotion regulation strategies are often effective, not all

effortful emotion regulation yield positive results (i.e. negative reappraisal). However, good executive functioning is often an asset when regulating emotions, and in many situations, one cannot effectively regulate without an effortful strategy. Researchers have hypothesized that rumination and other counterproductive emotion regulation strategies may be negatively correlated with executive control, even depleting cognitive resources (Davis & Nolen-Hoeksema, 2000).

Emotion and Executive Functioning

Modulation of self-directed behavior and emotions has been found to require adequate "high level" cognitive abilities, or executive functions (Banich, 2009; Rogers et al., 2004). Presently, executive functions are considered to be a set of cognitive skills including the ability to plan, inhibit, initiate, organize, and self-monitor as well as effortfully guide behavior toward a goal, particularly in non routine situations (Banich, 2009). Psychologists are interested in executive functioning because it is the mechanism through which self-directed behavior occurs.

Theories of Executive Function

Executive skills develop as humans develop, growing and maturing through adolescence and beyond in the frontal cortex of the brain. The prevailing conceptualization of executive functioning is that it is a multidimensional construct which includes processes designed to prioritize and sequence behavior, inhibit stereotyped behaviors, and create and maintain attention for relevant task information. Executive functioning is also involved in ability to switch between goals and utilize

relevant information when making decisions (Banich, 2009). Current models theorize that the processes underlying executive functioning is not unitary, as previously thought, and can be separated into components (Baddeley,1998). Recently, Miyake, Friedman, Emerson, Witzki, and Howerter, (2000) showed that executive functioning can be fractionated into three more basic executive processes: (1) shifting back and forth between multiple tasks or mental sets ("shifting"), (2) monitoring incoming information for relevance to the task at hand and then appropriately updating the informational content by replacing old, no longer relevant information with newer, more relevant information ("updating"), and (3) deliberately inhibiting dominant, automatic, or prepotent responses ("inhibition"; Miyake et al., 2000). While these three operations share some common elements, Miyake et al. (2000) found that they are somewhat separable, with different complex executive tests loading heavily on just one or two of these specific operations.

In addition, results from focal lesion studies have found that there are three primary types of executive functioning ability located in different areas of the frontal cortex. These type of executive functioning include 1.) response initiation and perseverance in the medial prefrontal cortex 2.) task setting in the left lateral regions and 3.) self-monitoring in the right lateral regions (Stuss & Alexander, 2007.)

Research suggests that executive functioning is a difficult construct to measure due to the evidence for both unitary and nonunitary components of executive functioning (Jurado & Roselli, 2007), and the fact that while most tests of executive functioning were developed using patients with frontal lobe damage, the precise nature of the

executive function necessary for the accurate performance on these tasks is unspecified (Miyake et al., 2000). In addition, it is difficult to attain adequate reliability due to tests being designed to assess the ability to cope with novel problems, which cease to be novel after the first administration (Salthouse, Atkinson, & Berish, 2003). However, tests have been developed to assess aspects of executive functioning, such as cognitive flexibility, inhibition, abstraction, concept formation, planning, and rule detection. Tests include: the Stroop Test, (Stroop, 1935), which primarily measures ability to inhibit responses and shift sets, the Trail Making Test (TMT, Reitan, 1955), which measures cognitive flexibility, the Wisconsin Card Sorting Test (WCST; Berg, 1948), which measures cognitive flexibility, concept formation, planning, abstraction, and rule detection, and the Controlled Oral Word Association Test (COWAT; Benton and Harnsher, 1989), which primarily measures planning and cognitive flexibility.

Executive Function, Emotions, and Emotion Regulation

The emotion regulation section of this prospectus noted that there is an association between emotion regulation and executive abilities. In fact, emotion regulation has been associated with executive functioning in some studies (e.g. Joormann & Gotlib, 2010; Gyurak, Goodkind, Madan, Kramer, Miller, & Levenson, 2009).

A close relationship between emotion regulation and effort exists, such that self-regulation of emotions requires a degree of effort by the individual. However, emotion regulation strategies have been found to differ in the amount of effort they require. Some forms of emotion regulation have been found to be more effortful (Ochsner & Gross,

2008), while others are more automatic (Mauss, Bunge, & Gross, 2007). For example, Ochsner, Bunge, Gross, and Gabrieli (2002) found that neural activation in reappraisal (an antecedent-focused, cognitive strategy) recruited broad regions of the left prefrontal cortex, an area relevant for executive functioning. In contrast, automatic emotion regulation, which often occurs unconsciously (Mauss et al., 2007), was associated with activity in the lateral cerebellum, which studies have associated with automatic initiation and execution of motor programs. These functional differences in brain activation during different types of emotion regulation highlight the differences in cognitive effort and processing that may exist between automatic and effortful emotion regulation.

Research by Gyurak and colleagues investigated the relationship between the emotion regulation strategy of suppression and executive ability. Specifically, studies looked at whether executive functioning was related to ability to downregulate, or suppress, emotional responses in individuals with degeneration of frontotemporal brain regions. Participants included neurotypical individuals and those with frontal-temporal dementia and Alzheimer's Disease. Responses to a startle "gunshot" noise were measured by somatic activity and facial expressive behavior. Results indicated that ability to physically suppress emotions was negatively associated with executive functioning as measured by verbal fluency. This relationship was consistent across groups (Gyurak et al., 2009).

The relationship between executive functioning and rumination has been investigated in several studies. Davis & Nolen Hoeksema (2000) found that a ruminative cognitive style was related to a cognitive style marked by perseveration and inflexibility

as measured by the WCST. In addition, a study by Philippot and Brotoux (2007) explored the effects of induced rumination versus distraction on executive function of college students and found that rumination led to decreases in inhibition in dysphoric individuals. Watkins & Brown (2002) have also examined this association and determined that a causal relationship existed between rumination and executive dysfunction as measured by a random number generation task.

Studies have also found that the emotion regulation strategy of reappraisal is related to executive functioning. In by study by Joormann and Gotlib (2010) of depressed, nondepressed, and depression vulnerable individuals, results showed that formerly depressed, or depression-vulnerable participants employed less reappraisal, more rumination, and greater suppression strategies, which were related to higher levels of depressive symptoms, indicating that individuals with prior depression retain maladaptive emotion regulation strategies even though they are not currently experiencing an episode of depression. Results also indicated that reduced inhibition was related to less use of reappraisal and more use of suppression across groups.

In sum, several studies have found that emotion regulation is associated with executive functioning, with some results indicating that less helpful strategies tend to involve lower levels of executive processes. Theories as to why this is the case have been posited. Nolen-Hoeksema and colleagues indicated that perhaps rumination, and other mind-occupying emotion regulation strategies, fill cognitive space that diminishes available executive resources (Davis and Nolen-Hoeksema, 2000). The possibility also

exists that limited executive capacity leaves fewer cognitive resources available to regulate emotions, particularly in depression (Joorman & Gotlib, 2010).

Are Variations in Executive Functioning associated with Depression?

If it is the case that executive functioning moderates the relationship between stress and depression, it would be expected that correlations between executive functioning and depression would be small and possibly inconsistent. Mixed results in the literature regarding the relationship between executive functioning and depression have been evidenced. Evidence for executive dysfunction in depressed individual has been found in several studies. In a study by Behnken et al. (2010), results demonstrated that individuals in remission from depression had more difficulty encoding and cognitively organizing nonverbal information than controls. They suggested that interventions for depression should target improving cognitive organizational ability. More support for neuropsychological deficits in depressed individuals was evidenced in a study by Landro, Stiles, and Sletvold (2001). Landro and colleagues found that for a population of individuals with unipolar major depressive disorder, overall neuropsychological deficits were evidenced. Results demonstrated that participants performed disproportionately worse in the two domains of selective attention and working memory. Further, Klein and Boals (2001) found that individuals with more life event stress performed more poorly on a working memory task. They also found that life event stress predicted intrusion errors and that self-reports of intrusive and avoidant thinking predicted functional working memory capacity.

Though many studies have found a negative relationship between depression and executive functioning, findings have been somewhat mixed. Whitmer and Banich (2007) found that in a nondepressed sample, individuals who scored high on subscales of rumination , including 'reflection' and 'brooding,' had more difficulty inhibiting previously learned responses, while depressive rumination was not associated with this deficit. Further, in a study concerning neuropsychological differences between bipolar and unipolar depressed participants, Sweeney, Kmiec, and Kupfer (2000) found that those with unipolar depression had difficulties with episodic memory, but this was not as severe as the individuals who were diagnosed with bipolar disorder. Those with bipolar disorder performed significantly worse on measures of working memory and episodic memory. Additionally, in a study utilizing a small sample of depressed individuals and age-matched controls, Purcell, Maruff, Kyrios, and Pantelis (1997) did not find such working memory deficits in depressed individuals.

Mixed findings were also evident in a study by Ravnkilde et al., (2002). In a clinical sample of depressed individuals, Ravnkilde and colleages found that widespread impairment in cognitive functions was evident, affecting attention, memory, visuomotor speed, and language. However, aspects of executive functioning, such as categories completed on the WCST, simple memory span, and verbal learning were not affected (Ravnkilde, et al., 2002). Executive functioning has also been studied with regard to autobiographical memory and information processing. Research has shown autobiographical memory can be affected in depression-vulnerable individuals (Gibbs & Rude, 2004). In a study by Dalgleish et al. (2007), it was hypothesized that the

established relationship between impaired autobiographical information processing and depression was related to impaired executive control. Results indicated that autobiographical information processing was associated with performance on measures of executive control; however, this was independent of depressed mood. Interestingly, they also found that executive control mediated the relationship between depressed mood and autobiographical information processing. Researchers posited that reduced executive control drives the relationship between depressed mood and poor autobiographical information processing.

Does executive functioning buffer the effects of life stress, thereby reducing risk of depression? Though some studies have found that executive functioning is unrelated to psychopathology, a preponderance of evidence suggests that better executive functioning may promote adaptive emotion regulation and act as a buffer for individuals to keep from developing psychopathology, such as depression. These mixed results warrant further investigation on the relationship between executive functioning and depression.

Depression is often the result of life stressors. Research has found that vulnerability factors, such as difficulty regulating emotions, are related to subsequent onset of depression. Recently, studies have demonstrated that emotion regulation strategies, such as reappraisal, rumination, and suppression, are related to executive functioning. Could executive function potentially moderate the relationship between life-stress and depression?

PROPOSED RESEARCH STUDY

Statement of Purpose

The aim of this study is to explore the possible moderating effect of executive functioning on the relationship between life stressors and depression. The association between life stress and depression has been studied extensively (see Hammen, 2005; Mazure, 1998), and studies have found that stressful life events often predate the onset of depression, as well as subsequent recurrences. Though life stressors are an important contributing factor to onset of depression, studies have found that other factors can also contribute to depressive episodes. Individual vulnerability factors, such as emotion regulation ability, can interact with life stress to create vulnerability to depression. The current study seeks to expand this body of literature by investigating the contribution of executive functioning to buffer or exacerbate vulnerability to depression.

Based on the supposition that limited executive function would be a particular liability when confronted with stressful life events, it is hypothesized that executive functioning deficits will interact with life stress to predict depression at Time 2, such that participants with low scores on a measure of executive ability, as indicated by number of perseverative errors on the WCST, will be expected to show greater levels of depressive symptomatology at Time 2 as a function of the number of stressful life events between Time 1 and Time 2.

In addition, emotion regulation will be regressed on executive functioning. Based on the premise that suppression and rumination would occupy executive resources that

could be allocated for processing task relevant information, it is hypothesized that these emotion regulation strategies will be inversely correlated with executive functioning.

The proposed study will use college students and will assess changes in depression as a function of life stress and executive functioning across a 4-6 week period. Students will be prescreened to select those who would be prone to episodes of dysphoria, but will not be currently depressed as judged by self-report. The rationale for this choice is that individuals who have had previous bouts of depression are more susceptible to subsequent episodes (e.g. Gortner et al., 2006).

Method

Approval by Human Subject Committee

The proposed study will be in compliance with the guidelines set forth by the Institutional Review Board for the Protection of Human Subjects at the University of Texas at Austin and with the Ethical Principles of the American Psychological Association (2002).

Prescreening

Before students would be assigned to the study from the subject pool, potential subjects would be prescreened with the Inventory to Diagnose Depression-Lifetime Version (IDDL). In this questionnaire, students would be asked about their depression history. Students would be selected for the study if this episode of depression was not

current, but met criteria for a past depressive episode. Students with a history of dysphoria will be selected due to increased depression vulnerability.

Further screening procedures would be involved to ensure students were not previously tested on the Wisconsin Card Sorting Test. Participants would be asked the following, "Have you participated in neuropsychological testing before? If so, or you think you have, did you complete a task involving cards in which you received feedback of 'yes or no'?" Studies suggest that on retest, the Wisconsin Card Sorting Test is no longer novel and is unable to measure problem-solving abilities in the same manner as on the initial test (Paolo, Axelrod, & Troester, 1996).

Students would also be asked questions regarding history of significant neurological illness or brain injury and presence of learning disabilities. The presence of these conditions has been found to impact performance on the WCST. If students denied previous testing using the card task and denied presence of these conditions currently or in their lifetime, they would be eligible for the study.

Participants

Participants would be 119 undergraduate students recruited through the Department of Educational Psychology's subject pool at the University of Texas at Austin. The participants would be a sample selected with the aforementioned prescreening criteria. Participants would be designated as having a previous depressive episode if they reported experiencing a two-week period in which they were sad and/or anhedonic and had a total of at least five major depressive symptoms. These criteria map

onto DSM-IV symptomotology for major depressive disorder. For the proposed statistical analyses, (testing of the moderation hypothesis), power level of .95 and an alpha of .05, a G*Power (Erdfelder, Faul, & Buchner, 1996) analysis suggested a sample size of 119. Participants will receive course credit in return for participation in the study.

Instruments

Demographic survey. A demographic survey will be given to all participants requesting: age, sex, and ethnicity.

Depression

The *Center for Epidemiologic Studies Depression Scale* (CES-D; Radloff, 1977) is a 20-item self-report measure that is designed to be used in the general population. This instrument asks participants to indicate how often they experienced particular depressive symptoms during the past week. Scores on the CES-D range from zero to 60 and higher scores are indicative of more severe depressive symptomotology. The CES-D has demonstrated adequate internal consistency with an average coefficient alpha of .86 and test-retest reliability with correlation coefficients ranging from .45 to .70 (Radloff, 1977). Further, the CES-D appears to discriminate between inpatient populations and the general public (Radloff, 1977). The scale is also moderately correlated with other measures of depression, such as the Hamilton Clinician's Rating Scale (HCRS). Upon admission to an inpatient unit correlations between the CES-D and HCRS ranged from .44 to .54; one month following treatment correlations ranged from .69 to .75 (Radloff, 1977).

The *Inventory to Diagnose Depression, Lifetime Version* (IDDL; Zimmerman & Coryell, 1987) would be used to assess presence of MDD in the participants' lifetime, and the severity of symptoms. This 22-item self-report measure is based upon the Diagnostic and Statistical Manual of Mental Disorders, 3rd edition criteria for MDD. Each item consists of five statements and asks respondents to choose the sentence that best reflects the time period in which they were the most depressed. Further, individuals are required to indicate whether the symptoms they endorsed were present for two or more weeks. This inventory has demonstrated good internal consistency with a Cronbach's alpha of .92 and split-half reliability with a Spearman-Brown coefficient of .90 (Zimmerman & Coryell, 1987). The IDDL has also shown good test-retest reliability at a one month interval with a kappa of .77 (Sato et al., 1996). In addition, there appears to be convergence between the IDDL and structured interviews designed to diagnose psychiatric disorders (Zimmerman & Coryell, 1987).

Emotion Regulation

Ruminative Response Scale. The Ruminative Response Scale (RRS), which is a subscale of the Response Styles Questionnaire (RSQ; Nolan-Hoeksema & Morrow, 1991), would be used to assess the way in which participants respond to their depressed mood. More specifically, this 22-item self-report inventory measures respondents' reactions to depressed mood that are self-focused, symptom-focused, and consequence-focused. The instrument has sufficient two year test-retest reliability (r=.67) and good convergent and predictive validity (Nolen-Hoeksema & Morrow, 1991; Treynor,

Gonzalez, & Nolen-Hoeksema, 2003). In the present study the brooding and reflection subscales of the RRS will be used. Cronbach's alpha for the reflection subscale was .72 and the test re-test reliability for this subscale was .60 (Treynor et al., 2003). Coefficient alpha for the brooding subscale was .77 and the test re-test reliability was .62 (Treynor et al., 2003). Treynor et al. (2003) recognizes that the relatively low alpha levels were due in part to being calculated with few items. Internal consistency reliabilities for the brooding and reflection subscales were .70 and .74, respectively. Treynor et al. (2003) found that though brooding and reflection were associated with more depression concurrently, only brooding was found to be predictive of future depression.

Emotion Regulation Questionnaire. The Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) is a 10-item paper-and-pencil measure that assesses two factors of emotional regulation: suppression and reappraisal. On each subscale individuals are asked to rate their agreement with items on a seven-point Likert scale, 1 corresponds with strongly disagree and 7 corresponds with strongly agree. The emotional suppression subscale consists of items such as, "I control my emotions by not expressing them" and "I keep my emotions to myself". Examples of items on the reappraisal subscale include "I control my emotions by changing the way I think about the situation I'm in" and "When I am faced with a stressful situation I make myself think about it in a way that helps me stay calm". Coefficient alpha reliabilities averaged .79 for the reappraisal scale and .73 for the suppression scale (Gross & John, 2003). Gross and John (2003) reported that test-retest reliability for both scales was .69. The suppression and reappraisal scales of the ERQ demonstrated sufficient convergent and discriminant

validity with measures of inauthenticity, mood regulation, coping, and personality (Gross & John, 2003).

White Bear Suppression Inventory The White Bear Supppression Inventory (WBSI: Wegner & Zanakos, 1994) is a 15-item paper-and-pencil self-report questionnaire which is used to assess tendency to suppress distressing thoughts. The inventory contains items that are rated on a five-point Likert scale (1-strongly agree, 5-strongly agree). Examples of items assessing thought suppression is "There are things I prefer not to think about" and "I have thoughts that I cannot stop." Greater thought suppression is noted by higher scores. The WBSI has demonstrated good internal consistency and test-retest reliability (Muris, Merckelback, & Horselenberg, 1996).

Executive Function

Wisconsin Card Sorting Test. The Wisconsin Card Sorting Test (WCST; Berg, 1948) will be used to measure aspects of executive function, including cognitive flexibility, set shifting, and abstraction. It will be administered and scored in a standardized format (Heaton, Chelune, Talley, Kay, & Curtiss, 1993). In the WCST, participants attempt to determine what rules should be used to sort 128 cards to match key cards that vary in three stimulus dimensions (color, shape, and number) based on examiner feedback. Norms for the WCST were derived for individuals aged 6-89 years of age by Heaton and colleagues (Heaton et al., 1993). The test yields scores for the following six indices: total correct, perseverative responses, perseverative errors, nonperseverative errors, conceptual level responses, and categories completed.

Interscorer and intrascorer reliability were excellent in some studies (interclass correlations above .83; Axelrod, Goldman, & Woodward, 1992). With regard to test-retest reliability, Basso, Bornstein, & Lang (1999) found that at in a group of 50 healthy young men, at a 12-month retesting there was significant improvement on nearly all indices. Studies suggest that the low stability of the WCST may reflect that on retesting, it is no longer measuring problem-solving abilities in the same manner (Paolo et al.,1996). Basso and colleagues indicated that it is likely that procedural knowledge of test demands and effective test-taking strategies are retained, thereby shaping and enhancing subsequent performance (Basso, Bornstein, & Lang, 1999). A confirmatory factor analysis from a mixed sample of patients and nonclinical controls found the six principal scores for the WCST, including total correct, perseverative responses, perseverative errors, nonperseverative errors, conceptual level responses, and categories completed loaded on three-factors (Greve, Stickle, Love, Blanchin, & Stanford, 2005). However, only the first factor (comprising Perseverative Responses, Percentage Concept Level Responses, Categories Completed, and Total Correct) was found to reflect general executive functioning. With regard to correlations with other measures of executive functioning, investigators have reported that indices of perseveration on the WCST show modest correlations (.19–.42) with measures of attention/working memory (e.g., Part B of the Trail Making Test, Continuous Performance Test, Digit Span). Structural equation modeling indicated that performance on the WCST was significantly predicted by the "shifting" ability (Miyake, Emerson, Friedman, 2000).

In this study only perseverative responses will be analyzed. Minshew, Meyer, & Godstein (2002) have observed that the WCST is not entirely a concept identification task and is perhaps best assessed by the perseverative error score. Rhodes (2004) suggests that the measure of perseverative errors may be the better metric of executive function if a single score from the WCST is to be used. Perseverative errors occur when the participant sorts according to a category that was formerly correct but is no longer in effect.

Stressful life events

The Negative Life Events Questionnaire (NLEQ; Saxe & Abramson, 1987). The NLEQ consists of 66 items that are rated on a 5-point scale ranging from 0 to 4 (0 = *never present*; 4 = *always present*) on how frequently they had occurred during the past 4-6 weeks. Items reflect concerns likely to be relevant to college students such as "Criticized by one or more roommates." Saxe and Abramson (1987) reported a test-retest reliability of .82 for the NLEQ and its validity has been supported in a study by Metalsky and Joiner (1992). Metalsky and Joiner (1992) supported the validity of the NLEQ with the finding that scores interacted with a measure of negative cognitive schema to predict concurrent and future depressive symptoms.

Procedure

Overview. The proposed study utilizes a prospective cohort design and multiple linear regression statistics. The two time points will be coordinated with the approximate beginning of the semester (about one month into the semester as per subject pool

availability; Time 1) and midterm examinations approximately 4-6 weeks later (Time 2), in anticipation of greater levels of stress at Time 2.

Time1. Time 1 would occur when the subjects are allocated to the study by the department, approximately one month into the semester. Each participant would arrive at an individual session and complete consent forms. Then, participants would select a five-digit code based on their mothers' first name and their birthday. This code would allow the data from the 2 sessions to be linked while, at the same time, removing identifiable information. Subsequently, demographic information will be collected. The anonymous questionnaire battery would include self-report questionnaires of depression (CES-D), emotion regulation (ERQ, WESI, RRS), and life stress (NLEQ). After completing the questionnaires, each participant would be administered the measure of executive functioning (WCST).

Time 2. Time 2 would occur during the midterm week of the semester, approximately 4-6 weeks after Time 1. Participants would complete the CES-D and NLES questionnaires for a second time. The final part of Time 2 would ask participants to rate how honestly and accurately they answered the questions on a 5-point Likert scale (1 "not honest or accurate" to 5 "completely honest and accurate"). This rating would be used to exclude participants who were not honest from the analyses.

Analyses

Preliminary Analyses

Part of the preliminary analyses would include calculation of descriptive statistics. This includes means and standard deviations of all measures: depression, lifetime depression severity, life stress, suppression and reappraisal, rumination, and executive functioning. Additionally, demographic information will be included, such as age ranges, and race/ethnic composition of participants. Visual inspection of data will be essential prior to conducting the analyses to help uncover any outliers as well as check for skewed data and kurtosis. Frequency distributions will be calculated. Homoscedasticity and normality of data will also be checked using scatterplots. Assumptions of ANCOVA will be checked by visually inspecting scatterplots to ensure linear relationships with the dependent variable. Homogeneity of covariance will be determined by testing significance of interactions to ensure a parsimonious model. Once checks on the assumptions have been made and preliminary analyses conducted, analyses will be performed based on the research questions.

To test the statistical significance of the interaction, depression will be regressed on life stress and executive functioning. Variables will be entered simultaneously. Then, in a sequential fashion, the interaction term will be added to the equation. Before testing the model, the data will be mean-centered to reduce multicollinearity (Aiken & West, 1991; Cohen, Cohen, West, & Aiken, 2003). Time 1 scores of stress and depression will be used as covariates in multiple regression analysis. This will reduce error variance by

controlling for participants' individual differences and thus provide a sensitive statistical test. An alpha value of .05 would be used for all statistical tests.

Specific Analyses

Hypothesis 1: It is hypothesized that participants with high levels of life stress, as measured by the NLEQ at Time 2, will have significantly higher levels of depressive symptomatology, as measured by the CES-D at Time 2.

Analysis 1. Regression analysis will be performed with the independent variable NLEQ at Time 2 and the dependent variable CES-D at Time 2, controlling for Time 1 CES-D and NLEQ scores.

Rationale 1. A large body of research points to the relationship between high levels of life stress and onset of depression (Hammen, 2005). Studies demonstrate that significant life events can lead to shifts in thoughts, mood, and behavior, which can lead to developing psychopathology, such as depression. Data suggest that approximately 50% of individuals diagnosed with depression have experienced severe stress before onset (Mazure, 1998).

Hypothesis 2: It is hypothesized that an interaction between life stress and executive functioning will occur with respect to effect on depression. Executive functioning, as measured by WCST, is predicted to moderate the overall effect of life stress on depression, such that the impact of life stress, as measured by the NLEQ, will be reduced as a function of executive functioning, resulting in lower depressive symptoms,

as measured by the CES-D.

Analysis 2. To quantify the effect of executive functioning in multiple regression analyses, the study will regress Time 2 depression (CES-D2) on Time 1 depression and life stress (CESD1, NLEQ1), Time 2 life stress (NLEQ2) , executive functioning (WCST), and the executive functioning by life stress interaction term (cross product of WCST and NLEQ2). Time 1 depression and life stress variables will be thought of as covariates and entered first. Next the first order effects of Time 2 life events and of executive functioning will be entered. In the final step, the interaction between executive functioning and Time 2 life events will be evaluated with all other variables in the model.

Rationale 2. Research has found that life stress often leads to depression, but successful coping with life stressors can occur, particularly when the individual has good cognitive coping abilities (Gross, 1998). Research has found that limited executive abilities are related to more difficulty regulating emotions (e.g. Davis & Nolen-Hoeksema, 2000), leading to greater susceptibility to depression under stressful conditions. This study will test whether executive functioning moderates the influence of life stress on depression.

Hypothesis 3: It is hypothesized that participants' executive ability, as measured by the WCST, will be positively correlated with use of the emotion regulation strategy of reappraisal, as measured by the ERQ.

*Analysis 3. The c*orrelation between ERQ (reappraisal) and the WCST will be

assessed.

Rationale 3. Reappraisal involves changing a situation's meaning in such a way that there is a change in the person's emotional response to that situation (Gross, 2002). Gross posits that the emotion regulation strategy of reappraisal occurs in the early phases of emotion generation, at the cognitive level. Reappraisal has been found to activate prefrontal regions of the brain (Ochsner, Ray, Gabrielli, & Gross, 2004) and involves an effortful cognitive process requiring attention and abstraction (Berkman & Lieberman, 2009). Thus, a relationship is likely to exist between executive resources and ability to reappraise.

Hypothesis 4: It is hypothesized that participants' executive ability, as measured by the WCST, will be inversely correlated with use of the emotion regulation strategy of rumination, as measured by the ERQ.

Analysis 4. The correlation between RRS and WCST will be assessed.

Rationale 4. Rumination is conceptualized by Nolen-Hoeksema as a maladaptive response style in which individuals respond to distress in a way that involves repetitively and passively focusing on symptoms (Nolen-Hoeksema, 1991). Rumination is associated with poor problem solving skills (Hong, 2007) and more negative appraisals of situations. Davis & Nolen Hoeksema (2000) found that a ruminative cognitive style was related to perseveration and cognitive inflexibility. In addition, a study by Philippot and Brotoux (2007) explored the effects of induced rumination versus distraction and found that rumination lead to decreases in inhibition in dysphoric individuals.

Hypothesis 5: It is hypothesized that participants' executive ability, as measured by the WCST, will be inversely correlated with use of the emotion regulation strategy of expressive suppression, as measured by the ERQ.

Analysis 5. The correlation between ERQ (suppression) and WCST will be assessed.

Rationale 5. Suppression is a form of response modulation that involves inhibiting, or decreasing, ongoing emotion-expressive behavior (Gross, 2002). Inhibition and modulating expressive behavior is an effortful process which is thought to utilize cognitive resources, perhaps recruiting executive resources needed to complete effortful tasks to the detriment of task completion. Along these lines, Gyurak, Goodkind, Madan, Kramer, Miller, & Levenson (2009) found that ability to physically suppress emotions was negatively associated with executive functioning.

Hypothesis 6: It is hypothesized that participants' executive ability, as measured by the WCST, will be inversely correlated with use of the emotion regulation strategy of thought suppression, as measured by the WESI.

Analysis 6. The correlation between WESI and WCST will be assessed.

Rationale 6. Suppressing distressing thoughts is an effortful cognitive process which involves shifting attention to lessen distressing thoughts, as well as inhibiting and monitoring intrusive thoughts. Inhibition, monitoring, and shifting attention are effortful processes which utilizes cognitive resources. Perhaps recruiting executive resources

needed to complete effortful executive tasks like the WCST will be more difficult when engaging cognitive resources for thought suppression.

DICUSSION

Summary

Depression is important to study due to its association with poor health and life outcomes. Many factors can contribute to one's vulnerability to developing depression, such as executive functioning, life stress, and emotion regulation strategies. The relationship between life stress and depression, as well as the relationship between emotion regulation and depression has been studied extensively (Hammen, 2005; Gross, 2002), with use of rumination and suppression correlating with depression, particularly when used long term (Nolen-Hoeksema, 1991; Gross & Thompson, 2007), while use of reappraisal strategies generally is predictive of positive mental health outcomes (Gross, 1998). More recently, the relationship between executive functioning and emotion regulation strategies has been investigated, with results indicating that executive functioning is correlated with emotion regulation strategies (Davis & Nolen-Hoeksema, 2000; Watkins & Brown, 2002; Jorrmann & Gotlib, 2010; Gyurak et al., 2009). These results imply that executive resources could act as a buffer to developing depression. This hypothesis is consistent with Gross's Antecedent- Response- Focused theory of emotions and emotion regulation, as he indicates that well-being is associated with use of emotion regulation strategies at the cognitive (antecedent) level. The present study seeks to understand the impact of executive functioning on the relationship between life stress and

depression.

The current study proposes that if an individual has average to high average executive functioning, as measured by perseverative responses on the WCST, they will be better protected against developing depression than someone with lower executive ability. Well developed executive functioning is thought to lead to better emotion regulation strategy utilization (Joorman & Gotlib, 2010). Should the hypotheses be upheld, the results would suggest that executive ability could serve as a buffer from the effects of life stress and developing depressive symptomatology. Findings can be discussed with respect to developing therapeutic techniques to enhance executive abilities and protect against stress and depressive symtomatology.

Implications

If the interaction hypothesis is supported, it will suggest that executive abilities play an important role in the relationship between life stress and depression. This could have significant implications for therapeutic interventions, as it would offer foundational support for a new perspective on depression vulnerability. One facet of the life-stress literature focuses on the "kindling" phenomenon in which individuals who experience recurrences of depression require progressively less life stress to initiate depressive episodes. Post and colleagues introduced the hypothesis that recurrent depression can become progressively independent of stressors, as a function of neurobiological changes associated with repeated stressors and episodes that create a sensitization "kindling." This is posited to lead to more spontaneous episodes of depression. Though the study

will not address specific neurobiological changes, it will elaborate on the impact of executive, frontal functions on the relationship between life stress and depression. In this regard, interventions could focus on strengthening executive control functions to buffer the impact of life stress and limit subsequent depression vulnerability.

A theoretical implication of this research concerns the life-event matching model, or congruency model. This theory posits that schemas about the self and others contribute to appraisals of events (Hammen, 2005), which can lead to psychopathology. Experiences thereby trigger depression for certain individuals, but not for others. The findings from this study could implicate executive dysfunction as a factor in the life-event matching model, leading to depressive, "default" schemas and causing individuals to have poor problem solving and regulation skills, thus incurring more matching life events. It could be that limited executive resources contribute to this default, or easily accessible, mode of operation that often produces depression.

Further, emotion regulation has been associated with depression in many studies, with some strategies being better, and others worse, for emotion management and dealing with negative feelings. Should the study find correlations between executive functioning and the emotion regulation strategies of suppression, rumination, and reappraisal, it will add to the body of literature on emotion regulation and executive functioning.

Limitations and Future Directions

The study has some limitations worth mentioning. First, the study utilizes student volunteers, many of whom would come from the same classes. Therefore, a selection

bias may exist that may make generalization to other populations difficult. Furthermore, as the participants will be college students as opposed to a clinical population, it is possible that the initial levels of life stress and depression could be low at Times 1 and 2. In addition, there is the possibility that the use of prescreening questionnaires will restrict the range of the variables and subsequently, effects which might exist could be missed. Further, the findings might not be generalizable to those with severe stress and/or clinical depression. In addition, executive functioning scores could be relatively high in this college student population.

Though the longitudinal design of the study is a particular strength of the design and creates the possibility of a stronger causal inference to be made, the correlational nature of the data is a limitation. While correlational studies can suggest that there is a relationship between two variables, they cannot prove that one variable causes a change in another variable.

Measures of executive functioning are developed through testing on those with frontal lobe damage. Therefore, these measures are often criticized for not being sensitive to nuances of executive impairment. The sensitivity of the WCST to frontal impairment has been criticized, as well as its unreliability. Though the measure is widely used and has demonstrated adequate psychometric properties in many studies, studies have also found that the test-retest reliability of the WCST is relatively low. This is hypothesized to be due to the nature of task in which novelty is a necessity; however, it is a limitation nonetheless.

The self report questionnaires utilized in this study can also be considered a limitation. However, to counter the possibility that participants would not take the experiment seriously, sessions would be done in person and participants would be asked at the end of the first session if they gave the task their full attention, and at the end of the second session if they answered honestly and accurately. It is hoped that students who did not give their full attention and effort to the task could then be filtered out. However, the possibility of inaccuracy due to the self-report nature of the checks remains.

Finally, depression-vulnerability status was only assessed using a self-report measure. Though the measure retains adequate psychometric properties, and a diagnostic interview would have been time consuming, an interview would have been a more precise assessment of depression history and current depressive symptomatology.

The current study takes an important first step in the investigation of executive functioning as a vulnerability factor in the relationship between life stress and depression. Since the WCST is primarily measuring aspects of executive functioning, future studies should test the moderating effects of other aspects of cognitive functioning, such as memory. Future directions could also involve use of community samples. Understanding the impact of executive functioning on the life stress-depression relationship could be particularly important in those from stressful economic and family situations.

Appendix A

Demographic Page

1. What is your sex?

   ___ Male

   ___ Female

2. What is your age?

   ___

3. What is your race?

   ___Asian

   ___Black

   ___Latino/Hispanic

   ___Native American

   ___White

   ___Bi or Multi-Racial

   ___Other:

4. Please enter the first 3 letter of your mother's first name followed by the 2 digit month and 2 digit day of your birthday. For example, if your mother's name is Elizabeth and your birthday is June 5th, your code would be: "ELI0605." Please use all CAPITAL letters.

   This code will allow us to match up the different parts of your data. We will not be attempting to identify you using this information.

   _____

Appendix B

CES-D

INSTRUCTIONS: Below is a list of some of the ways you may have felt or behaved. Please indicate how often you have felt this way during the ***past week*** by circling the appropriate number.

	Rarely or None of the Time (Less than 1 day)	**Some or a Little of the Time (1-2 days)**	**Occasionally or a Moderate Amount of the Time (3-4 days)**	**Most or All of the Time (5-7 days)**
1. I was bothered by things that usually don't bother me.	1	2	3	4
2. I did not feel like eating; my appetite was poor.	1	2	3	4
3. I felt that I could not shake off the blues even with help from my family or friends.	1	2	3	4
4. I felt that I was just as good as other people.	1	2	3	4
5. I had trouble keeping my mind on what I was doing.	1	2	3	4
6. I felt depressed.	1	2	3	4
7. I felt that everything I did was an effort.	1	2	3	4
8. I felt hopeful about the future.	1	2	3	4

9. I thought my life had been a failure.	1	2	3	4
10. I felt fearful.	1	2	3	4
11. My sleep was restless.	1	2	3	4
12. I was happy.	1	2	3	4
13. I talked less than usual.	1	2	3	4
14. I felt lonely.	1	2	3	4
15. People were unfriendly.	1	2	3	4
16. I enjoyed life.	1	2	3	4
17. I had crying spells.	1	2	3	4
18. I felt sad.	1	2	3	4
19. I felt that people disliked me.	1	2	3	4
20. I could not get "going."	1	2	3	4

Appendix C

Inventory to Diagnose Depression – Lifetime Version

INSTRUCTIONS: In this next section, try to **remember *the week in your life you felt the most depressed***.

What was the approximate starting and ending date of the episode you have in mind?

began:_____ ended:_____

Indicate the number of the one statement that best describes how you felt. Remember to **also circle whether you felt that way for *more* or *less* than two weeks.**

1) **0** I did not feel sad or depressed.

1 I occasionally felt sad or down.

2 I felt sad most of the time, but I was able snap out of it. .

3 I felt sad all the time, and I couldn't snap out of it.

4 I was so sad or unhappy that I couldn't stand it.

this lasted **MORE / LESS** than two weeks.

2) **0** My energy level was normal.

1 My energy level was occasionally a little lower than normal.

2 I got tired more easily or had less energy than is usua1

3 I got tired from doing almost anything.

4 I felt tired or exhausted almost all of the time.

this lasted **MORE / LESS** than two weeks.

3) **0** I was not feeling more restless and fidgety than usual.

1 I felt a little more restless or fidgety than usual.

2 I was very fidgety, and I had some difficulty sitting still in a chair.

3 I was extremely fidgety, and I paced a little bit almost everyday.

4 I paced more than an hour per day, and I couldn't sit still.

this lasted **MORE / LESS** than two weeks.

4) **0** I did not talk or move more slowly than usual.

1 I talked a little slower than usual

2 I spoke slower than usual, and it took me longer to respond to questions, but I could still carry on a normal conversation.

3 Normal conversations were difficult because it was hard to start talking.

4 I felt extremely slowed down physically, like I was stuck in the mud.

this lasted **MORE / LESS** than two weeks.

5) **0** I did not lose interest in my usual activities.

1 I was a little less interested in 1 or 2 of my usual activities.

2 I was less interested in several of my usual activities.

3 I have lost most of my interest in almost all of my usual activities.

4 I have lost interest in all of my usual activities

this lasted **MORE / LESS** than two weeks.

6) **0** I got as much pleasure out of my usual activities as usual.

1 I got a little less pleasure from 1 or 2 of my usual activities.

2 I got less pleasure from several of my usual activities.

3 I got almost no pleasure from several of my usual activities.

4 I got no pleasure from any of the activities that I usually enjoy.

this lasted **MORE / LESS** than two weeks.

7) **0** My interest in sex was normal.

1 I was only slightly less interested in sex than usual.

2 There was a noticeable decrease in any interest in sex.

3 I was much less interested in sex.

4 I lost all interest in sex.

this lasted **MORE / LESS** than two weeks.

8) **0** I did not feel guilty.

1 I occasionally felt a little guilty.

2 I often felt guilty.

3 1 felt quite guilty most of the time.

4 I felt extremely guilty most of the time.

this lasted **MORE / LESS** than two weeks.

9) **0** I did not feel like a failure.

1 My opinion of myself was occasionally a little low.

2 I felt I was inferior to most people.

3 I felt like a failure.

4 I felt I was a totally worthless person.

this lasted **MORE / LESS** than two weeks.

10) **0** I didn't have any thoughts of death or suicide.

1 I occasionally thought life was not worth living.

2 I frequently thought of dying in passive ways (such as going to sleep and not waking up) or that I'd be better off dead.

3 I had frequent thoughts of killing myself.

4 I tried to kill myself.

this lasted **MORE / LESS** than two weeks.

11) **0** I could concentrate as well as usual.

1 My ability to concentrate was slightly worse than usual. .

2 My attention span was not as good as usual and I had difficulty collecting my thoughts; but this didn't cause any problems.

3 My ability to read or hold a conversation was not as good as usual.

4 I could not read, watch TV, or have a conversation without great difficulty.

this lasted **MORE / LESS** than two weeks.

12) **0** I made decisions as well as usual.

1 Decision making was slightly more difficult than usual

2 It was harder and took longer to make decisions, but I did make them.

3 I was unable to make some decisions.

4 I couldn't make any decisions at all.

this lasted **MORE / LESS** than two weeks.

13) **0** My appetite was not less than normal.

1 My appetite was slightly worse than usual. .

2 My appetite was clearly not as good as usual, but I still ate.

3 My appetite was much worse.

4 I had no appetite at all, and I had to force myself to eat even a little.

this lasted **MORE / LESS** than two weeks.

14) **0** I didn't lose any weight.

1 I lost less than 5 pounds

2 I lost between 5-10 pounds.

3 I lost between 11-25 pounds.

4 I lost more than 25 pounds.

(If you circled #1,2,3, or 4: Were you dieting and deliberately trying to lose weight? YES NO)

this lasted **MORE / LESS** than two weeks.

15) **0** My appetite was not greater than normal.

1 My appetite was slightly greater than usual.

2 My appetite was clearly greater than usual.

3 My appetite was much greater than usual.

4 I felt hungry all the time.

this lasted **MORE / LESS** than two weeks.

16) **0** I didn't gain any weight.

1 I gained less than 5 pounds.

2 I gained between 5-10 pounds.

3 I gained between 11-25 pounds.

4 I gained more than 25 pounds.

this lasted **MORE / LESS** than two weeks.

17) **0** I was not sleeping less than normal.

1 I occasionally had slight difficulty sleeping.

2 I clearly didn't sleep as well as usual.

3 I slept about half my normal amount of time.

4 I slept less than 2 hours per night.

this lasted **MORE / LESS** than two weeks.

18) **0** I was not sleeping more than normal.

1 I occasionally slept more than usual.

2 I frequently slept at least 1 hour more than usual.

3 I frequently slept at least 2 hours more than usual.

4 I frequently slept at least 3 hours more than usual.

this lasted **MORE / LESS** than two weeks.

19) **0** I did not feel anxious, nervous, or tense.

1 I occasionally felt a little anxious.

2 I often felt anxious.

3 I felt anxious most of the time.

4 I felt terrified and near panic.

this lasted **MORE / LESS** than two weeks.

20) **0** I did not feel discouraged about the future.

1 I occasionally felt a little discouraged about the future.

2 I often felt discouraged about the future.

3 I felt very discouraged about the future most of the time.

4 I felt that the future was hopeless and that things would never improve.

this lasted **MORE / LESS** than two weeks.

21) **0** I did not feel irritated or annoyed.

1 I occasionally got a little more irritated than usual.

2 I got irritated or annoyed by things that usually didn't bother me.

3 I felt irritated or annoyed almost all the time.

4 I felt so irritated that I could not think about anything else.

this lasted **MORE / LESS** than two weeks.

22) **0** I was not worried about my physical health

1 I was occasionally concerned about bodily aches and pains.

2 I was worried about my physical health.

3 I was very worried about my physical health.

4 I was so worried about my physical health that I could not normally bother me.

this lasted **MORE / LESS** than two weeks.

Have you experienced any other times when you felt as bad as you did during this time?

Yes ____ No _____ If yes, please estimate the number of additional times: ____

Appendix D

Ruminative Responses Scale

INSTRUCTIONS: Please read each of the items below and indicate how often, ***within the past 2 weeks,*** you have thought or done each one. Please indicate what you *generally* have done, not what you think you should do.

	Almost Never	**Sometimes**	**Often**	**Almost Always**
5. Think "What am I doing to deserve this?"	0	1	2	3
7. Analyze recent events to try to understand why I am depressed.	0	1	2	3
10. Think "Why do I always react this way?"	0	1	2	3
11. Go away by myself and think about why I feel this way	0	1	2	3
12. Write down what I am thinking and analyze it	0	1	2	3
13. Think about a recent situation, wishing it had gone better	0	1	2	3

15. Think “Why do I have problems other people don’t have?”	0	1	2	3
16. Think “Why can’t I handle things better?”	0	1	2	3
20. Analyze my personality to try to understand why I am depressed.	0	1	2	3
21. Go someplace alone to think about my feelings.	0	1	2	3

Appendix E

Emotion Regulation Questionnaire (ERQ)

Instructions and Items

We would like to ask you some questions about your emotional life, in particular, how you control (that is, regulate and manage) your emotions. The questions below involve two distinct aspects of your emotional life. One is your emotional experience, or what you feel like inside. The other is your emotional expression, or how you show your emotions in the way you talk, gesture, or behave. Although some of the following questions may seem similar to one another, they differ in important ways.

Using the following 7 point scale, please answer the following questions about yourself by indicating the extent of your agreement:

	Strongly Disagree			Neutral			Strongly Agree
1. When I want to feel more *positive emotions* (such as joy or amusement), I *change what I'm thinking about.*	1	2	3	4	5	6	7
2. I keep my emotions to myself.	1	2	3	4	5	6	7
3.When I want to feel less *negative* emotion (such as sadness or anger), I *change what I'm thinking about*.	1	2	3	4	5	6	7
4. When I'm feeling positive emotions, I'm careful not to express them.	1	2	3	4	5	6	7
5. When I'm faced with a stressful situation, I make myself *think about it* in a way that helps me stay calm.	1	2	3	4	5	6	7
6. I control my emotions by not expressing them.	1	2	3	4	5	6	7

7. When I want to feel more *positive emotion*, I *change the way I'm thinking* about the situation.	1	2	3	4	5	6	7
8. I control my emotions by *changing the way I think* about the situation I'm in.	1	2	3	4	5	6	7
9. When I'm feeling *negative emotions*, I'm careful not to express them.	1	2	3	4	5	6	7
10. When I want to feel less *negative* emotion, I *change the way I'm thinking* about the situation.	1	2	3	4	5	6	7

Appendix F

White Bear Suppression Inventory (WBSI)

Instructions and Items
This survey is about thoughts and emotions. There are no right or wrong answers, so please respond honestly to each of the items below. Don't work too fast, but don't spend too long on any one item either.

Using the following 5 point scale, please answer the following questions about yourself by indicating the extent of your agreement:

	Strongly Disagree		Neutral		Strongly Agree
1. There are things I prefer not think about.	1	2	3	4	5
2. Sometimes I wonder why I have the thoughts I do.	1	2	3	4	5
3.I have thoughts that I cannot stop.	1	2	3	4	5
4. There are images that come to my mind that I cannot erase.	1	2	3	4	5
5. My thoughts frequently return to one idea.	1	2	3	4	5
6. I wish I could stop thinking of certain things.	1	2	3	4	5
7. Sometimes my mind races so fast I wish I could stop it.	1	2	3	4	5
8. I always try to put problems out of mind.	1	2	3	4	5

9. There are thoughts that keep jumping into my head.	1	2	3	4	5
10. Sometimes I stay busy just to keep thoughts from intruding on my mind.	1	2	3	4	5
11.There are things I try not to think about.	1	2	3	4	5
12. Sometimes I really wish I could stop thinking.	1	2	3	4	5
13. I often do things to distract myself from my thoughts.	1	2	3	4	5
14. I have thoughts that I try to avoid.	1	2	3	4	5
15. There are many thoughts that I have that I don't tell anyone.	1	2	3	4	5

Appendix G

Negative Life Events Questionnaire (NLEQ)

INSTRUCTIONS: In this questionnaire we are interested in whether certain events have happened to you in the past 4 to 6 weeks. The questions can be answered by referring to the following scale:

A	B	C	D	E
NEVER	**RARELY**	**SOMETIMES**	**FREQUENTLY**	**ALWAYS**

Some questions do not follow this format. For these questions, a scale for answering will be provided after the question.

****If no scale is provided then use the scale at the top of the page.****

Please be careful to mark your answers correctly and you are to evaluate each question for only the past 4-6 weeks.

SCHOOL

1. Did poorly on, or failed, an exam or major project in an important course (i.e. grade less than or equal to a C.) _____

2. Received a negative reaction from family or friends about not doing well in school (e.g. got the silent treatment, got criticized) _____

3. Doing worse academically than usually did in previous semesters or than I did in high school (difference of at least one grade; e.g. C rather than a B.) _____

4. Negative consequences from studying for long periods of time (e.g. exhaustion, ill health, loss of friends, etc.) _____

5. Do not have time to do well in school or job (e.g. work long hours so have no time to study.) _____

6. Dislike school in general, but have to stay (e.g. forced by parents to stay, have no skills to get a job, etc.) _____

7. Not doing as well in school as would like _____

A B C D E

NEVER RARELY SOMETIMES FREQUENTLY ALWAYS

JOB

8. Laid off or fired from job **A=NO B=YES**

9. Unable to find work and need a job very much for financial or other reasons _____

10. Reprimanded at work _____

11. Significant negative change in financial circumstances (e.g. large amount of money or valuables lost or stolen, significant decrease in financial support, etc.) _____

12. Did not have enough money for one or more necessities and had to do without them (or, when living with family, family did not have money for one or more necessities) (necessities are: health care, food, housing or necessary clothing.) _____

ACHIEVEMENT

13. Have not been achieving or accomplishing as much as I would like _____

14. Parents upset with me for not living up to their standards/expectations (e.g. not doing well in school, sports, etc.) _____

PARENTS AND FAMILY

15. Significant fight or argument with close family member that led to serious consequences such as self or family member crying, temporary loss of privileges, emotional distance, etc.) _____

16. Close family member became so upset with you that s/he ended the relationship _____

17. Trying but can't seem to fully please mother and/or father _____

18. Can't tell how family member really feels about you _____

19. Trying but can't seem to get close to one or more family members _____

20. Did something did not want to do in order to please family member _____

A	B	C	D	E
NEVER	RARELY	SOMETIMES	FREQUENTLY	ALWAYS

21. Death of parent, brother, or sister _____

22. Found out that close family member has been criticizing you behind your back _____

23. Fights or disagreements with one or more close family members _____

24. Put down by parents or parents show dislike _____

25. Parents disappointed in you _____

26. Family member has significant medical or emotional problem (e.g. heart disease, depression, excessive use of alcohol or drugs, etc.) _____

27. Family member has a life threatening illness _____

28. Conflicts with parents over (or parents do not support) personal goals, desires, or choice of friends _____

29. Did not receive love, respect, or interest from parents (e.g. did not receive compliments or praise from parents, parents did not call or write, parents did not listen or show interest, etc.) _____

30. Forced by parents to achieve things that could not or did not want to achieve (e.g. have to be a star athlete though would rather concentrate on other interests, punished if do not excel in everything undertaken, etc.) _____

31. Close family member has been withdrawing affection from you _____

ROOMMATES

32. Trying but can't seem to fully please roommate _____

33. Criticized by one or more roommates _____

34. Can't tell how one or more roommates really feels about you _____

35. Trying but can't seem to get close to one or more roommates _____

A B C D E

NEVER RARELY SOMETIMES FREQUENTLY ALWAYS

36. Did something did not want to in order to please roommate _____

37. Found out that roommate has been criticizing you behind your back _____

38. Fight or disagreement with one or more roommates _____

39. Roommate has been withdrawing affection from you _____

FRIENDS (OTHER THAN ROOMMATES)

40. Close friend becomes so upset with you that s/he ends the relationship _____

41. Trying but can't seem to fully please a friend _____

42. Criticized by one or more friends _____

43. Can't tell how one or more friends really feels about you _____

44. Trying but can't seem to get close to one or more friends _____

45. Found out that friend had been criticizing you behind your back _____

46. Death of a pet **A=NO B=YES**

47. Death of a friend **A=NO B=YES**

48. Have hardly any friends _____

49. Not sought out by others for activities or friendships (e.g. not called by others and asked to do something fun, etc.) _____

50. Close friend has been withdrawing affection from you _____

BOYFRIEND/GIRLFRIEND/SPOUSE

51. Significant fight or argument with boyfriend/girlfriend/spouse that led to serious consequence(s) such as self or boyfriend/girlfriend/spouse crying, leaving common residence for one night, etc.) _____

52. Boyfriend/girlfriend/spouse ends the relationship _____

A B C D E

NEVER RARELY SOMETIMES FREQUENTLY ALWAYS

53. Boyfriend/girlfriend/spouse says s/he is not sure whether wants relationship to continue _____

54. Trying but can't seem to fully please boyfriend/girlfriend/spouse _____

55. Criticized by boyfriend/girlfriend/spouse _____

56. Trying but can't seem to get close to boyfriend/girlfriend/spouse _____

57. Found out that boyfriend/girlfriend/spouse has been criticizing you behind your back _____

58. Discovered boyfriend/girlfriend/spouse has been cheating on you _____

59. Did something did not want to do in order to please boyfriend/girlfriend/spouse _____

60. While still involved with boyfriend/girlfriend/spouse s/he has a date with someone else _____

61. Death of a boyfriend/girlfriend spouse **A=NO B=YES**

62. Fight or disagreement with boyfriend/girlfriend/spouse _____

63. Can't tell how boyfriend/girlfriend/spouse really feels about you _____

64. Want a boyfriend/girlfriend/spouse but do not have one _____

65. Did not receive love, respect, or interest from boyfriend/girlfriend/spouse (e.g. did not receive compliments or praise, boyfriend/girlfriend/spouse did not listen or take interest in you, etc.) _____

66. Boyfriend/girlfriend/spouse withdrew affection from you _____

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